DOCUMENT RESUME

ED 180 352 HE 012 085

AUTHOR Rose, Clare: And Others
TITLE The Study of Women Scientists/Engineers in Academe.
PUB DATE 17 Aug 79
NOTE 36p.: Statistical tables may not reproduce well

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Academic Rank (Professional): Career Choice: *College Faculty: College Students: Educational Opportunities: *Employment Patterns: *Engineers: Equal Opportunities (Jobs): *Females: Graduate Study: Higher Education: Medicine: National Surveys: *Occupational Surveys: Psychologists: *Scientists: Social Sciences: Tenure

ABSTRACT

Academic employment and graduate enrollment trends of women scientists/engineers in eight scientific fields were studied, and the dynamics of their occupational choice and career stability were assessed. The eight fields were engineering, physical sciences, environmental sciences, medical sciences, psychology, and social sciences. The principal data sources were the National Science Foundation's "Survey of Scientific and Engineering Personnel Employed at Universities and Colleges" and the "Survey of Graduate Science Student Support and Postdoctorals." Data were also obtained from site visits from a representative sample of nine of the total 50 leading doctorate-granting institutions included in the study. It was found that women scientists/engineers are in a period of transition in their status in academe. Increasing numbers are entering graduate programs, and a large proportion are being employed in top-ranked institutions and departments. However, most women scientists/engineers are employed in nontenured, nonladder research scientist positions. Policy implications pertain to the funding of scientific research programs, educational programs in the sciences for women, and future research on the career development of women scientific professionals. (SW)

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THE STUDY OF WOMEN SCIENTISTS/ENGINEERS IN ACADEME

Clare Rose, Sally Ann Menninger, Glenn F. Nyre

Women have been active members of the scientific community for well over a century. But their numbers have been few and their status has been low; they have had few job opportunities, frequent unemployment, and they have seldom been considered eminent by their fellow scientists. The proportion of women scientists in academe continues to be small, and it drops significantly the higher the level of degree, academic rank, salary or administrative responsibility. These facts raise serious questions about the reality of equal opportunities for women as far as job access, position, promotion and salaries are concerned. Our study was designed to address these questions and to gain some insight into the problems, issues and concerns of women scientists/engineers in academe.

The Study

With the assistance of two grants from the National Science Foundation (NSF), the Evaluation and Training Institute investigated the employment and enrollment patterns of women scientists/engineers and graduate students in 8 major scientific fields: Engineering, Physical Sciences, Environmental Sciences, Medical Sciences, Psychology, and Social Sciences. The first part of the study consisted of a series of statistical analyses of institutional and departmental patterns in

NE 012 085

Award Presentation, American Educational Research Association, 1979 Award for Outstanding Research on Women, AERA National Conference, San Francisco, April 11, 1979.

women's full-time graduate enrollment and employment in science and engineering in the 50 leading doctorate-granting institutions.

The second phase of the study consisted of site visits to a case study sample of 9 institutions selected to represent the diversity of the original sample in terms of geographic location, urban/rural environment, institutional size, type of control (public/private) and proportion of women scientists employed. The case study institutions were the University of Arizona, Harvard University, Louisiana State University (Baton Rouge), University of Michigan, Northwestern University, Purdue University, University of Southern California, Texas A & M University and the University of Washington. The sampling matrix developed for the selection of the site visit institutions is displayed in Table 1.

The principal data sources for the study were: 1) the National Science Foundation's Survey of Scientific and Engineering Personnel Employed at Universities and Colleges, collected annually from approximately 2,300 institutions (including two-year colleges) and 2) the Survey of Graduate Science Student Support and Postdoctorals, collected annually from about 7,800 departments in approximately 360 doctorate-granting institutions. All statistical analyses are based on data from these surveys and include full-time employees and graduate students only. Part-time employees and students are not included in the study.

The goal of the analyses was to search for consistent and significant differences in the institutional distributions of

TABLE 1. SITE VISIT INSTITUTIONS SORTED BY GEOGRAPHIC REGION, TYPE OF CONTROL, SIZE OF SCIENCE AND ENGINEERING POPULATION AND PERCENTAGE OF FULL-TIME WOMEN SCIENTISTS AND ENGINEERS, JANUARY, 1979

% WOMEN SCIENTISTS & ENGINEERS EMPLOYED FULL-TIME	WEST	MID-WEST	SOUTH	EAST
OVER 20%	U. OF WASHINGTON LARGE - PUBLIC	U. OF MICHIGAN LARGE - PUBLIC		
OVER 15%	U. OF SO. CALIFORNIA SMALL - PRIVATE		LOUISIANA STATE U. LARGE - PUBLIC	
OVER 10%				HARVARD U. LARGE - PRIVATE
OVER 5%	U. OF ARIZONA MEDIUM - PUBLIC	NORTHWESTERN U. SMALL - PRIVATE		
BELOW 5%		PURDUE U. SMALL - PUBLIC	TEXAS A&M U. LARGE - PUBLIC	

men and women scientists according to six variables: size of institution, geographical location, source of support, institutional orientation toward research or teaching, and quality ranking of departments. No specific research hypotheses were formulated as to the effect of these variables on the enrollment/employment of women scientists. Rather, this research was exploratory and descriptive in nature.

FINDINGS FROM STATISTICAL ANALYSES

Distribution of Women Scientists and Graduate Students

Contrary to the literature on women academics generally, women scientists/engineers employed full-time in academe are concentrated in the very largest institutions. The fifty institutions drawn for the study sample from the 1976 survey population were the largest science schools -- those reporting the largest number of full-time scientists and engineering employees. These fifty schools accounted for only 2 percent of all the institutions surveyed in 1976, but they employed almost 35 percent of the full-time women scientists/engineers reported by the 2,300 institutions in that year.

Overall, women constituted 16.4 percent of the total study employee sample. As Table 2 indicates, however, the overall percentage of women in each field varies a great deal. Women are the most prominent in psychology, where they comprise 25% of the employees, and least prominent in engineering, where they comprise only 3 percent of the engineering employees.

TABLE 2. WOMEN SCIENCE/ENGINEERING EMPLOYEES AS A PERCENTAGE OF TOTAL SCIENCE/ENGINEERING EMPLOYEE POPULATION, IN 50 LEADING UNIVERSITIES AND COLLEGES, BY FIELD, JANUARY, 1976

Field of Specialization	Size of Science & Engineering Employee Population			Overall Percentage	Chi Square	Level of Significance
	small less than 1250	medium 1251-1649	large more than 1650			
Engineering	1.0	1.7	5.0	3.2	87.15	.001
Physical Science	4.0	5.5	7.4	6.0	20.77	.001
Environmental Science	4.2	4.4	7.3	5.8	8.99	.05
Mathematical Science	8.4	9.4	10.5	9.6	3.2	NS
Agricultural & Biological Science	16.7	21.9	19.1	19.1	37.58	.001
Medical Science	16.1	21.4	24.1	21.5	106.34	.001
Psychology	18.3	28.2	27.7	25.3	23.18	.001
Social Science	20.6	15.7	20.3	19.0	25.14	.001
All Fields	13.8	16.6	17.7	16.4	117.16	.001

NOTE: Since the chi square test is dependent upon sample size, our interpretation of the chi square values was made in the context of a careful examination of the corresponding percentage distributions of men and women resulting from the breakdown of the data by the criterion variables. The employee counts were large, even within the various fields, and significant chi square values resulted in some cases in which comparison of the distributions of men and women showed little difference. The focus in examining the chi square tables was not on specific values, however, but on the identification of general patterns or trends.

As far as graduate students are concerned, almost 24 percent of the approximately 105,000 graduate students in the study sample are women. Table 3 indicates that the distribution of women graduate students in the sciences parallels the distribution of women science employees. Graduate women too are the most visible in psychology, where they comprise 45 percent of the graduate student count, and they are least visible in engineering, where only 5 percent of the graduate students are women.

The distributions of both women employees and graduate students across the various disciplines in the study sample reflect the traditional career patterns of women in the sciences. Although there have been significant increases in the number of graduate women entering the hard sciences in the past five years, women have been, and continue to be concentrated in the life sciences, the social sciences and psychology; they have been, and continue to be least visible in the more technical disciplines such as engineering and the physical sciences.

Institutional Size

In order to determine if institutional size and related organizational variables affected the proportion of women scientists employed or enrolled at a given school, chi square analyses were performed to determine if the percentage of women at an institution differed with the size of the institution, measured first by size of scientific and engineering employee population, and then by size of total student population. Two sep-

TABLE 3. WOMEN SCIENCE/ENGINEERING GRADUATE STUDENTS AS A PERCENTAGE OF TOTAL SCIENCE/ENGINEERING GRADUATE STUDENT POPULATION IN THE 50 LEADING UNIVERSITIES AND COLLEGES BY SIZE OF STUDENT BODY, BY FIELD, FALL 1975

FIELD OF SPECIALIZATION	SIZE OF STUDENT BODY			OVERALL PERCENTAGE	CHI SQUARE	LEVEL OF SIGNIFICANCE
	SMALL < 16,000	MED. 16-30,000	LARGE > 30,000			
ENGINEERING	6.4	5.6	4.9	5.5	25.10	.001
PHYSICAL SCIENCE	11.4	13.1	10.9	11.7	21.14	.001
ENVIRONMENTAL SCIENCE	12.0	14.3	12.3	13.1	3.49	N.S.
MATHEMATICAL SCIENCE	13.4	21.4	17.1	17.9	27.25	.001
AGRICULTURAL & BIOLOGICAL SCIENCES	29.7	24.5	25.0	25.4	34.73	.001
MEDICAL SCIENCE	38.9	43.0	40.1	40.8	3.07	N.S.
PSYCHOLOGY	43.3	45.2	44.3	44.5	.65	N.S.
SOCIAL SCIENCE	33.1	32.5	35.2	33.7	13.14	.01
ALL FIELDS	21.6	25.3	23.5	23.8	78.37	.001

arate measures of institutional size were used because each measure reflects different aspects of an institution's environment. In these analyses, the proportion of women in each category of institutional size was compared to the total proportion of women in all schools combined.

The range of institutional size among the schools was restricted, as indicated, since these were the fifty schools with the largest employee counts of scientific personnel. Even within the sample, however, there was considerable variation. The employee count of scientific personnel varied from a high of 3,090 at the largest school, to a low of 735 at the smallest. Student body size ranged from a high of 58,814 to a low of 8,040.

When size of employee population is the criterion, the distribution of women science employees as shown in Table 2 indicates that, as a group, women scientists are concentrated in the largest schools. They are about 18 percent of the total employee count in schools with a scientific employee population of more than 1,650 compared to 14 percent of the total in small schools with an employee population of less than 1,250. This pattern held consistently in all but three of the eight fields.

When institutional size is measured by student count (Table 4), women scientists/engineers are found in equal proportions in large and small schools (18 percent). In medium-sized schools, their proportion drops to 14 percent. This pattern held across fields, with the exception of the Mathematical Sciences.

TABLE 4. WOMEN SCIENCE/ENGINEERING EMPLOYEES AS A PERCENTAGE OF TOTAL SCIENCE/ENGINEERING EMPLOYEE POPULATION IN THE 50 LEADING UNIVERSITIES AND COLLEGES BY SIZE OF STUDENT BODY, JANUARY, 1976.

Field of Specialization	Size of Student Body			Overall Percentage	Chi Square	Level of Significance
	small less than 16,000	medium 16,000-30,000	large more than 30,000			
Engineering	3.3	1.3	4.7	3.2	58.95	.001
Physical Science	5.6	4.4	7.6	6.0	22.95	.001
Environmental Science	6.1	4.0	7.6	5.8	10.32	.01
Mathematical Science	6.2	10.1	10.4	9.6	9.84	.01
Agricultural & Biological Sciences	22.3	17.3	19.8	19.1	243.01	.001
Medical Science	21.9	16.1	27.6	21.5	273.40	.001
Psychology	29.2	21.4	27.6	25.3	12.90	.01
Social Science	22.8	17.0	19.3	19.0	23.10	.01
All Fields	17.8	13.9	18.2	16.4	196.82	.001

In contrast to employees, the general pattern for the distribution of women graduate students remains the same regardless of which criterion of size is used. Slightly more prominent in mid-sized institutions, women graduate students are well distributed across the different categories of institutional size, as can be seen in Table 3.

Much of the literature talks about the importance of role models. In order to see if women science/engineering students are more attracted to graduate programs in which there are more women visible in professional roles, we examined the data to see if there was a relationship between the percentage of women employees and the percentage of women graduate students at any given institution. Table 5 summarizes the correlation coefficients of the percentages of women science and engineering employees and graduate students in the sample of 50 institutions.

The results of our analysis indicated that there was no consistent relationship between the proportions of women students and employees in the eight scientific fields in the study sample. Over all fields combined, there was a moderate positive correlation, but when the data were broken down by discipline, the value of the coefficients dropped drastically. These results do not disprove the importance of role models for women in professional training. We do not know what degree of contact women faculty have with graduate students or the extent of their influence on postgraduate careers. But in the 50 institutions we studied, women were enrolling in science and engineering graduate programs, regardless of the presence or absence of women on the faculty and staff.

TABLE 5. CORRELATION COEFFICIENTS FOR PERCENTAGES OF SCIENCE AND ENGINEERING EMPLOYEES AND GRADUATE STUDENTS IN THE 50 LEADING UNIVERSITIES AND COLLEGES, BY FIELD, ACADEMIC YEAR, 1975-1976

Scientific Field	Correlation Coefficient
Engineering	-.14
Physical Science	.06
Environmental Science	.03
Math	.29
Agricultural & Biological Sciences	.32
Medical Science	.14
Psychology	-.22
Social Science	-.20
All Fields	.41

Geographic Distribution

Previous research has documented the influence of geography on the institutional distribution of academic personnel in general. There appears to be a tendency for both men and women to prefer positions in the same general region of the country in which they were born, but women academics have been shown to be geographically less mobile than men.

The distribution of academic science employees presented in Table 6, showed slight differences in the geographic dispersion of men and women. A larger percentage of the women than the men were found in the east and midwest, while more men than women were found in the south and west. Within the different fields, however, the distributions of men and women scientists vary, and no consistent pattern holds.

The geographic distribution of men and women graduate students is essentially equal except for a slightly higher concentration of women than men in the east (23 percent versus 21 percent respectively), no doubt in part due to the prevalence of women's colleges in the east.

Type of Support

Public and private institutions are dependent upon different sources of financial support and are subject to different kinds of outside pressure. The resulting differences in administrative policies, including personnel policies for recruitment, promotion, retention, and salary, may have an effect on the number of women scientists/engineers employed or enrolled at an institution.

TABLE 6. PERCENTAGE DISTRIBUTION OF MEN AND WOMEN SCIENCE AND ENGINEERING EMPLOYEES IN THE 50 LEADING UNIVERSITIES AND COLLEGES, BY GEOGRAPHIC REGION AND FIELD, JANUARY, 1976

Field of Specialization	Geographical Region				Chi Square	Level of Significance
	East	Midwest	South	West		
Engineers						
Women	26.2	48.4	14.5	10.9	25.51	.001
Men	25.5	35.5	19.2	19.9		
Physical Scientists						
Women	29.6	39.4	19.3	11.7	23.32	.001
Men	26.1	32.4	21.6	19.8		
Environmental Scientists						
Women	19.4	36.6	26.1	17.9	10.58	.01
Men	20.6	28.1	21.9	29.4		
Mathematical Scientists						
Women	27.4	34.1	25.9	12.7	8.87	.05
Men	24.3	36.1	21.7	15.8		
Agricultural & Biological Scientists						
Women	25.9	33.9	27.3	12.9	55.48	.001
Men	22.8	30.8	30.9	15.4		
Medical Scientists						
Women	28.1	40.4	11.5	20.1	180.94	.001
Men	25.9	38.3	18.6	17.3		
Psychology						
Women	30.0	36.7	23.2	.10	33.77	.001
Men	24.3	41.1	18.5	.16		
Social Scientists						
Women	24.4	35.1	26.1	.14	31.12	.001
Men	25.0	35.5	21.6	.18		
All Fields						
Women	26.9	37.4	19.7	15.9	112.03	.001
Men	24.7	35.0	22.5	17.8		

The results of a chi square test, however, indicated that there were no consistent differences in the percentages of men and women employees or students found in public or private schools. There was a slightly greater proportion of women employed in private schools compared to men (almost 32 percent vs. almost 31 percent, respectively), but for students, the distributions of men and women are almost identical (nearly 75 percent in public schools and 25 percent in private).

Institutional Emphasis: Research versus Teaching

Being associated with an institution or department attributed with significant research accomplishments is both an important asset to and a measure of individual career development. Past research indicates that academic women have been concentrated in smaller teaching-oriented schools and are found infrequently in prominent positions in large research universities.

In our study sample, 40 out of the 50 schools were classified as research-oriented and the largest proportion of both men and women scientists/engineers were employed in these schools. Ten of the sample schools reported on the NSF survey that teaching rather than research is the primary work activity of the majority of their science/engineering personnel, and these schools were classified as having a teaching emphasis (Table 7).

TABLE 7. PERCENTAGE DISTRIBUTION OF MEN AND WOMEN SCIENCE AND ENGINEERING EMPLOYEES IN THE 50 LEADING UNIVERSITIES AND COLLEGES CLASSIFIED BY EMPHASIS ON TEACHING VS. RESEARCH, BY FIELD, JANUARY, 1976

Field of Specialization	Institutional Emphasis		Chi Square	Level of Significance
	Research	Teaching		
Engineers				
Women	75.0	25.0	6.69	.01
Men	78.9	21.1		
Physical Scientists				
Women	79.0	21.0	.72	NS
Men	77.3	22.7		
Environmental Scientists				
Women	68.7	31.3	2.75	NS
Men	74.9	25.1		
Mathematical Scientists				
Women	87.8	12.2	5.96	.05
Men	83.3	16.7		
Agricultural & Biological Scientists				
Women	78.1	21.1	41.09	.001
Men	82.3	17.7		
Medical Scientists				
Women	70.6	29.4	40.24	.001
Men	74.5	25.5		
Psychologists				
Women	78.5	21.5	15.12	.001
Men	84.7	15.3		
Social Scientists				
Women	85.7	14.3	1.06	NS
Men	84.9	15.1		
All Fields				
Women	76.4	23.6	62.81	.001
Men	79.3	20.7		

Source: National Science Foundation

Our analysis suggests that there is still a slight tendency for a greater proportion of women than men to find employment in teaching-oriented schools (almost 24 percent compared to almost 21 percent, respectively). As indicated by Table 7, this pattern is found in five of the eight fields, including engineering, environmental science, agricultural and biological science, medical science and psychology.

On the other hand, women graduate students in the study sample are found in higher percentages than men in schools classified as research-oriented; almost 83 percent of the women students were enrolled in these schools compared to almost 81 percent of the men. Table 8 indicates that this pattern of differences, though small, is found in all fields with the exception of engineering, agricultural and biological sciences, and psychology. Whether or not these graduate students will continue on in research careers in academe is, of course, open to speculation.

Prestige Level of Departments

Research has indicated that women are not fairly represented in top-ranked institutions or departments in academe. To test whether women scientists in the present study were employed and enrolled in prestigious places in proportion to men, an analysis was conducted on the departmental distributions of men and women in six fields. The ranking scheme was developed from the Roose-Anderson ranking of institutional quality derived from the ratings of faculty and administrators.

TABLE 8. PERCENTAGE DISTRIBUTION OF MEN AND WOMEN SCIENCE AND ENGINEERING GRADUATE STUDENTS IN THE 50 LEADING UNIVERSITIES AND COLLEGES CLASSIFIED BY EMPHASIS ON TEACHING VS. RESEARCH, BY FIELD, FALL 1975

Field of Specialization	Institutional Emphasis		Chi Square	Level of Significance
	Research	Teaching		
Engineers				
Women	73.6	26.4	6.29	.05
Men	77.0	23.0		
Physical Scientists				
Women	80.8	19.2	10.74	.01
Men	78.6	21.4		
Environmental Scientists				
Women	72.8	27.2	2.15	NS
Men	69.7	30.1		
Mathematical Scientists				
Women	86.8	13.2	28.18	.001
Men	80.8	19.2		
Agricultural & Biological Scientists				
Women	82.1	17.9	4.09	.05
Men	83.1	16.9		
Medical Scientists				
Women	84.2	15.8	.49	NS
Men	83.7	16.3		
Psychologists				
Women	80.9	19.1	40.86	.001
Men	84.9	15.1		
Social Scientists				
Women	84.5	15.5	8.74	.01
Men	83.3	16.7		
All Fields				
Women	82.7	17.3	70.56	.001
Men	80.6	19.4		

Source: National Science Foundation

The results indicated that women scientists/engineers in the study sample were being employed in the top-ranked departments in their fields. In fact, across all fields, the percentage of women scientists/engineers employed in high quality departments was greater than or equal to the percentage of men. Women accounted for only 3 percent of the employees in engineering and 6 percent of those employed in the physical sciences. Yet, in both of these fields, the differences in the proportions of men and women in prestige departments is striking. In engineering, 88 percent of the women were in top-ranked departments as compared to 57 percent of the men. In the physical sciences, 65 percent of the women compared to 53 percent of the men were in top-ranked departments.

In psychology and the social sciences, women are well represented, accounting for 25 percent of the employee force in psychology and 19 percent in the social sciences. In these fields, the distribution of women across different quality departments did not differ greatly from the distribution of men. In psychology the distributions are almost identical; in the social sciences, 51 percent of the women compared to 46 percent of the men are found in the top-ranked departments. As the number of women increases within a discipline, their distribution across different quality departments grows more similar to the distribution of men. In other words, as the proportion of women in a field increases, sex becomes a less important variable in recruitment and promotion. This trend

was also apparent, though not as pronounced, in the data for graduate students.

FINDINGS FROM SITE VISITS

The NSF data used in this study included women scientists who are senior faculty at prestigious research schools, as well as women with baccalaureate degrees working as assistants in university research laboratories. Women in a variety of disciplines, a variety of positions and a variety of institutions were included. Yet, despite all this diversity, these women/scientists/engineers, as a group, exhibited certain career patterns which are very similar to women academics and women professionals in general. The quantitative analyses also indicated that these women scientists/engineers were being employed in the top-ranked departments in the 50 leading doctorate-granting universities and colleges, a finding which implies a significant gain in status for women scientists in academe. An important variable, however, was missing. The positions that these women were occupying could not be identified through statistical analysis, and questions concerning their status remained.

So during the 1977-78 academic year, we made site visits to the nine case study institutions listed previously. These

institutions were a representative sample of the 50 institutions that comprised the study sample. The distribution of women scientists in the various disciplines in the case study schools matched the distribution found in the sample of 50 institutions. Women were most prominent in psychology and the agricultural and biological sciences, and least well represented in engineering and the environmental sciences. The range for individual school means of the percent of women employed was also similar to that found in the larger sample -- with a low of 3.2 percent to a high of 26.3 percent. The percentage of women employed within the site visit schools was 15.5 percent, slightly less than the 16.4 percent found for women in the total sample. The site visits allowed us to probe behind the statistical data in order to more fully understand the institutional and departmental processes involved in the status of women scientists/engineers.

The Status of Women Scientists/Engineers

The purpose of the NSF surveys is to monitor the supply of scientific manpower resources in the United States, a charge given to NSF by the Office of Management and Budget in 1959. The problem is that while these surveys do provide an indicator of the science manpower resources in colleges and universities, they mask the dismal reality of women scientists' positions in academe. Headcounts and simple percentages do not reveal their ranks, salaries or job status. The site visits confirmed that these numbers are grossly misleading. The absolute numbers of women scientists/engineers may be increasing in some cases, but the percentages are small and women are still found in the lower ranks and untenured positions of academe.

We discovered that large numbers of women reported as full-time scientists/engineers on the NSF surveys, and for compliance with HEW requirements, hold off-ladder, non-tenured research scientist appointments, most often funded by extramural grants rather than general University funds. Many of these women have to find their own grants in order to receive a salary. For a few women, a research position was a voluntary and satisfactory choice, but for many it was a forced and unwelcome compromise. Many married doctorates were unable to obtain regular faculty positions because of institutional nepotism customs which, in practice, discriminate against women. Other women had received their doctorates at the institution where their husbands were employed, subsequently finding themselves

ineligible for faculty ladder positions because of the "we never hire our own" policy. Like nepotism practices, this policy protects an institution from losing its vitality and becoming sterile through inbreeding. Inherently not discriminating, in practice it severely discriminates against women, and the consequences are exceptionally severe when the university is an isolated area with limited or no alternatives for employment at other postsecondary institutions or in industry.

Research scientist positions can be valuable experiences for people who are beginning their professional careers, but these positions do not carry the prestige, high status or salary of regular faculty appointments. Along with other "adjunct" or "acting" positions, research scientists are for the most part a disenfranchised, second-class faculty whose grant moneys contribute overhead to the institutions. Denied the right to vote or even attend faculty meetings, they are responsible for serving on committees, teaching courses and supervising doctoral students. Even worse, these positions hinder professional development if they are held for a long period of time. Rarely are tenured faculty appointments made from among an institution's lecturers or research scientists, and seldom are these people recruited by other universities, particularly if they have held this type of appointment for more than a few years.

Unfortunately, the prospects for a dramatic change in the status of women scientists in the near future are slight, despite the increasing numbers of women entering scientific

fields. Women are entering the system and coming up for promotion just as retrenchment and tight budgets are reducing the number of faculty positions and tenure slots. The development of new programs has been curtailed and many programs have been cut back or eliminated. Few departments are expanding. In some instances, and this seems to be particularly true in the natural sciences and mathematics, there is a heavy concentration of older, tenured faculty, and only rarely does more than one position open up in a four to five-year period.

Instead of hiring new Ph.D.'s on tenure tracks, more and more colleges are turning to limited-term, contract appointments to bring in new blood and maintain departmental vitality. The term of appointment varies. Some institutions merely expand the one-year visiting professor plan as needed. In most institutions, the rotation cycle is three years; in a few, it is six years. In all cases, the positions are terminated and there is little or no chance of being retained on a permanent faculty status. Even worse, this practice creates a double bind. As one woman explained, her six-year position was terminating and there was no chance that she would be retained. She had applied for several positions at other institutions only to be told that she was "too old professionally". Those institutions, too, were looking for new or recent Ph.D.s to put on short-term appointments. Again, although this practice is not inherently discriminatory and applies equally to male as well as female appointments, the consequences are that it

severely limits the advancement of women in the academic world at a time when they are being encouraged to enter it.

In spite of the conditions of employment, however, we did find the atmosphere to be noticeably different at institutions which had a relatively high percentage of women scientists. Department chairmen* at institutions with few women were quick to describe their recruiting procedures as a search for "the best qualified candidate". "We'd love to hire a qualified woman," they said, "but we won't beat the bushes to look for her". But at institutions where there were comparatively more women scientists, deans and department chairmen added to the "best qualified" statement a consideration of women's more limited opportunities heretofore. These deans and department chairmen created an atmosphere of intention and action, using whatever means of affirmative action necessary, in the truest sense of the words, even if these means were non-traditional.

Department chairs can shift their needs to meet the qualifications of available women applicants or remain inflexible. In one large case study institution, the dean and several department chairs spoke of their willingness to "mortgage" an upcoming retirement slot if they found a woman who was well qualified in an area other than the one for which they were recruiting. In this way, they could meet the department's needs and still hire a qualified woman. Without affirmative action policies, it is doubtful that such social awareness and consciousness would have worked in quite this way.

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*The term chairmen is used purposefully, since all of those we met were men.

This spirit was also reflected in departments which will hire their own graduates in order to bring women into the field. It was reflected in the special courses established to help young women learn how to use basic tools that are usually part of a boy's li[illegible] was reflected in the special counseling courses designed to increase the retention of women in engineering.

Statistics are used by the courts both as a measure of discrimination and as a measure of compliance. When the evidence indicates that there has been a pattern of discrimination, the burden of proof is shifted to the employer, who must demonstrate that there is and has been no discrimination, that the job criteria are genuinely related to the job, and that employment practices and policies do not have and have not had a discriminatory effect. But institutional researchers, university administrators, department chairs, federal policy-makers and the courts should consider focusing less on the numbers of women employed or the numbers of women graduate students enrolled and more on who and where in the system these people are. Otherwise, the status of women in academe will not change.

Our impression from the site visits is that affirmative action is working, but to a limited degree. Women scientists /engineers are being allowed entrance to academe. In the case study institutions, in fact, women academics generally were receiving a somewhat larger share of the new hires because of affirmative action. But the door is rotating and they exit almost immediately, as most of these new positions are short-

term and the chances of becoming part of the tenured faculty are slim.

Future career patterns for women in scientific fields cannot be easily predicted. Although more women today than ever before are receiving graduate training in scientific disciplines, the pipeline has not been in place long enough to track the careers of younger women scientists in either academe or private industry.

We spoke to graduate women who were pursuing degrees in a variety of non-traditional areas -- oceanography, marine biology, marine science, fisheries, geosciences, mineral economics, spider ecology, geotechnics, watershed management and mine engineering. But in order to increase the potential pool of women scientists/engineers who are qualified for academe, the number of women receiving Ph.D.s in these fields must increase. Yet, the goal for the majority of the women, as well as the men graduates we met, was a master's degree and not a Ph.D.

Many women were enrolled in doctoral programs because there was no master's program available in that field or because stipends were only available for doctoral students. But they intended to leave when they had completed masters level work. Other women were leaving to get married.

Above all, the opportunities offered by private industry are the major reason few women continue graduate training to complete their Ph.D.s. Industry is making better offers in terms of salary and opportunity, and the offers are for mas-

master's and bachelor's degrees, not doctorates. We were told over and over again, at all the site visit institutions, that "industry is skimming our most talented women off at the bachelor's and master's level".

The recruitment efforts of private industry are now, and could well continue to be a significant source of competition to colleges and universities trying to meet affirmative action goals. Whether or not women who take these positions are promoted and advanced remains to be seen, but nevertheless these women cannot be included in the resource pool for academe.

Industry is clearly courting women, and is able to offer them excellent salaries and positions for less rigorous training than that required by academe. It also provides them with excellent opportunities to concentrate on their research undeterred by teaching responsibilities or publishing pressures. Contrary to the literature which suggests that women prefer teaching to research, the graduate women we interviewed and heard about, as a rule, preferred research to teaching. Private industry offers them this opportunity.

Academe, on the other hand, has little to offer: positions are few, salaries are poor, the training for a Ph.D. is long, and few institutions today can offer inviting prospects for a secure future.

Based on the findings of this study, we believe that women scientists in academe are in a period of transition. Since the 1970's women are moving into science and engineering in re-

cord numbers.

Regardless of what policies or programs are implemented by NSF or any other agency to attract women into scientific fields, women must take responsibility for moving into prestige positions in the scientific community. And they must continue to pursue careers in academe as well as in private industry, so they can contribute equally to the education and training of future generations of scientists. But academe, as well as private industry, must provide them the opportunity and the encouragement to do so.